

ON THE GENUS *NANNODYTHEMIS*, WITH DESCRIPTIONS OF NEW SPECIES.

[NEUROPTERA: *Odonata*.]

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(Plate vi.)

The genus *Nannodythemis* was proposed in 1868 by Brauer* to receive an aberrant species of the *Libellulinae* from Australia, which became the type under the name of *N. australis*. It is a short stumpy-looking insect with brilliant red abdomen; and as it sits about on the reed-stems, with its wings depressed and abdomen curved, it irresistibly suggests some kind of wasp. Brauer's specimens were from Moreton Bay, Queensland, and I have found it to be fairly common in coastal swamps in New South Wales, especially at Byron Bay.

While on a visit to Western Australia, in January, 1907, I found in a swamp at Wilgarrup, near Bridgetown, an insect very similar to the above species. I took it to be *N. australis*; but, later on, when I had the two series side by side in my collection, I could see considerable differences, not only of size, but of venation and colouration; and I made a note suggesting that the Western Australian form was a new species. However, as I possessed no description of Brauer's species and had not seen the types, I published the western species as *N. australis* Brauer,† only remarking on the greater size of the western form. Later on I wrote to Dr. Ris, the expert on *Libellulinae*, and to M. René Martin, mentioning these circumstances, and I was glad to find that they too had recognised, in de Selys' collection, two distinct

* Brauer, Verh. zool.-bot. Gesell. Wien, xviii. pp.369, 726(1868).

† See "The Dragonflies of Western Australia," these Proceedings, 1907, Vol.xxxii., p.723.

forms of *Nannodythemis*. I also obtained the information that Brauer's species was, as I had expected from its locality, most certainly the smaller form.

I now had materials for a short paper on the genus; but there was a further surprise in store for me. After making careful descriptions of the two species, I paid a visit to Wentworth Falls, hoping to get a better series of *N. australis* than I had at the time. There I took, in February of this year, two distinct species of this genus, one of which was certainly *N. australis*, but the other quite distinct from it and from the western form. Of the new form I was unfortunately only able to take four males and two females, but these, with my long series of the other two species, are sufficient to determine accurately the existence of three distinct but closely allied species of the genus.

Brauer distinguished his genus *Nannodythemis* from *Nannophya* Rambur* chiefly by the fact that the triangle of the hindwing is normal (*i.e.*, three-sided) in *Nannophya* while in *Nannodythemis* it is abnormal (*i.e.*, quadrilateral). Now in the two new species before me, which are evidently so closely allied to Brauer's *N. australis* that there can be no doubt as to their being congeneric, we find the following remarkable fact:—in the western form, the triangle of the hindwing in both sexes is normal; in the form from Wentworth Falls the males have normal triangles, while the two females I possess have an abnormal triangle in the hindwings. The former should then be placed in *Nannophya*, together with the male of the latter; while the female of the latter is a true *Nannodythemis*! The solution of this difficulty is an obvious one. Brauer, in creating the genus *Nannodythemis*, chose in defining it a variable character, which, far from being of true generic value, is not even of specific value. I can even find in my series of *N. australis* several individual specimens which possess a normal or nearly normal triangle in the hindwings, either on one side only or on both; while in my series of the western form careful examination reveals the

* Rambur, Ins. Névr. p.27(1842).

beginnings of a fourth side in one or two specimens. This extreme variability of the hindwing triangle causes it to lose absolutely its generic value, and the only course open to us is to suppress *Nannodythemis* Brauer, in favour of the older genus *Nannophya* Rambur. If the name *Nannodythemis* is to be retained at all, it must be used only as indicating a geographical subgroup of the principal genus *Nannophya*, to include the three Australian species which are so closely allied. And in this sense only I will retain the name in this paper, as I prefer that Dr. Ris should deal more fully with the two names in his great work on the "Libellulines" which will shortly be published.*

I propose to name the Western Australian form *N. occidentalis*, and to give to the third species (that from Wentworth Falls) the name of *N. Dalei* in memory of de Selys' great friend, the well-known British entomologist Mr. Dale; this name having already been applied by de Selys to this species on the label in his cabinet. In order to understand fully the differences between these three closely allied species, I will include a careful description of *N. australis* Br., taken from my own series.

1. *N. AUSTRALIS* Brauer. (Plate vi. fig.1).

♂. Total length 20-21 mm.; abdomen 13-13.5 mm.; forewing 14-14.5, hindwing 13.5-14 mm. Wings well rounded, neuration black, bases very slightly or not at all saffroned in mature specimens; in some less mature specimens there is saffroning up to arculus of forewing and from base to behind nodus of hindwing. *Pterostigma* 1 mm., dark brown between the black nervures, outer portion just whitish. Sectors of *arculus* arising together at or near its base. *Triangle* of forewings abnormal, the two portions of the upper side being practically equal; *triangle* of

* I have to thank Dr. Ris for showing me the generic difference; I myself did not possess the published definitions of the two genera until recently. Hence while I must put on record the two new species for inclusion in Dr. Ris' great work, I feel I should leave the full discussion of the generic differences to him who first discovered them.

hindwings also abnormal, the proximal portion of the upper side twice as long as the distal portion.* One cross-nervure in submedian space of forewing; *two* in that of hindwing. *Membranule* almost nil. *Nodal Indicator* $\begin{vmatrix} 5 & 4 \\ 4 & 4 \end{vmatrix}$ three to five single cells following triangle of forewings $\begin{vmatrix} 4 & 4 \end{vmatrix}$ (generally five). *Head*: *eyes* dark brown, paler beneath; *vertex* very small, tubercled, dull greyish or blackish, *antennæ* 1 mm., black; *front* well rounded, slightly indented behind medially, shining olive-grey, with stiff black hairs; *clypeus* olive-grey, hairy; *labrum* and *labium* ochreous, *mouth* edged with black. *Thorax*: *prothorax* dull blackish. *Meso-* and *metathorax* downy, black, carrying above, in the less mature specimens, a pair of narrow nearly straight antehumeral bands, bright lemon-yellow, about 2 mm. long, and slightly indented or hooked inwards anally; sides of thorax with a broader straight lateral yellow band followed by a less regular and slightly narrower black band below, then an irregular sub-lateral yellow band, then a wavy black line in the suture; rest of sides and underside yellowish; *notum* black, scuta and scutella yellow. *Legs* black with stiff spines, *coxæ* touched with yellow. In the more mature insect all these markings are obliterated by a covering of dull dark greyish pruinescence. *Abdomen*: 1-2 slightly enlarged, 3-5 very narrow cylindrical, 6 widening, 7-9 strongly dilated, flat underneath, 10 narrower. *Colour*: in the less mature insect, 1-6 black marked with orange-yellow as follows—1, an anal transverse band or two elongated anal spots; 2, orange, with a large dorsal area of black of variable shape, but generally much enlarged in the middle and stalked basally; 3, a pair of large basal spots, a pair of central spots, and a pair of very small anal spots, having an irregular black dorsal area, stalked basally, but very variable in shape; 4, a pair of basal spots and a pair of elongated central spots, or sometimes one long patch on each side; 5, an elongated spot on each side; 6, a larger suboval patch on each side. In the more mature insect 1-3 are covered with dull grey pruinescence, the sutures, dorsal ridge,

* I possess one or two specimens with the triangles practically normal.

and transverse carinae shining black; 4-5 nearly black, the orange markings more or less obliterated; 6 with the large spots red; 7-10 brilliant red, each segment sometimes with a more or less regular transverse anal black band, and sometimes unmarked except for a black point at the tip of the segment, low down on each side. Appendages: *superior* 0·8 mm., narrow, wavy, sublanceolate, carrying a few fine hairs; just touching near tips; pointed, red. *Inferior* 0·6 mm., subtriangular, tip slightly upcurved, orange-red.

♀. Total length 19-21 mm; abdomen 12·5-13·5 mm.; forewing 15-16 mm.; hindwing 14·5-15·5 mm. Wings as in ♂ but with a considerable amount of saffroning, extending in forewings nearly to arculus, and in hindwings covering a larger area nearly to arculus, lighter along costa, and another light patch along nodus. Head: *eyes* paler than in male, bright ochreous underneath; *front*, *clypeus* and *labrum* yellower than in male. Thorax as in the less mature male. Abdomen wider and more cylindrical than in male; colour black, marked with orange as follows—1, a transverse anal band; 2, sides orange crossed by a thick black line on the transverse carina; 3, a large orange patch on each side; 4-6, an elongated oval spot or patch on each side; 7, a very large oval spot on each side; 8, a smaller subtriangular spot on each side; 9, a pair of small basal lateral spots; 10, black, suture orange. Underside black with large semielliptical yellowish spots on either side of each segment, 2-6 downy beneath. Appendages separate, 0·4 mm., subconical, pointed, hairy, orange with black tips.

Hab.—Queensland: Moreton Bay—New South Wales: Byron Bay, National Park, Wentworth Falls, and probably on all coastal swamps and mountain bogs. It appears at the end of September, when it may be found sitting in characteristic attitude on the reed and grass-stems, with wings very much depressed and abdomen somewhat curved inwards. It continues on the wing until February. Its flight is irregular, close to the surface of the water, or in and out among the reed-stems. The females are less active and are found in the thicker parts of the reed-beds.

2. *N. DALEI*, n.sp. (Plate vi. fig. 2).

♂. Total length 23-25 mm.; abdomen 15-16 mm.; forewing 17·5-18·5 mm., hindwing 16·7-17·7 mm. Wings: neurulation black, bases touched with saffron for 1 mm. in forewings and 1·5 mm. in hindwings. *Pterostigma* 1·3-1·6 mm., black, touched with white at inner end and with a small triangular area of white at its outer end. Only one cross-nervule in submedian space of all wings. *Triangle* of forewings abnormal, the proximal portion of the upper side about twice as long as the distal portion; *triangle* of hindwings normal. 2-3 single cells following triangle of forewings (generally 2). *Nodal Indicator* ||5 5-6
Membranule almost nil Head: *eyes* brown, occipital ||4 5-6
triangle black above, yellow underneath, hairy; *vertex* and *antennae* black; *front* well rounded, deeply cleft medially, yellow covered with thick black hairs, a large black patch in front; *clypeus* yellow, sometimes touched with black; *labrum* yellow with a small black patch in the middle; *labium* yellow, mouth edged with black. Thorax: *prothorax* black, with a small dorsal double spot, yellow. *Meso-* and *metathorax* jet black with fine hairs, a touch of yellow along the dorsal ridge; on each side an antehumeral lemon-yellow band, narrow, slightly indented or hooked inwards anally; sides bright yellow, with irregular black lines in sutures, underside yellow; *notum* black, *scuta*, *scutella*, and some small spots on wing-bases orange-yellow. In the more mature insect these markings are all much duller and darker, but I have seen no signs of pruinescence even on specimens taken as late as February. Abdomen broader and less pinched than in *N. australis*; 1-3 slightly enlarged, 4-5 very slightly narrower, 6 widening, 7-9 dilated, but not so much, proportionately, as in *N. australis*, 10 narrower. Colour: 1-4 orange-red marked with black as follows—1, a transverse black band; 2, dorsal area more or less widely black; 3, an irregular longitudinal dorsal black band or line, enlarged anally, the transverse carina more or less black; 4, a longitudinal dorsal black band, enlarged at both ends, very variable; 5-6 very variable,

bright red, a dorsal line or band of black, thick or thin, enlarged anally; 7-10 brilliant red; 7-8 sometimes touched with black dorsally; a touch of black in sutures. Appendages: *superior* 1 mm.; separate, narrow, wavy, sublanceolate, carrying fine hairs, just touching near tips; red or orange-red touched with black at tips. *Inferior* 0.8 mm., subtriangular, tip slightly upcurved; orange.

♀. Total length 22 mm.; abdomen 14 mm.; forewing 17.5 mm.; hindwing 16.7 mm. Wings as in male, *except triangle of hindwings, which is abnormal*. Head as in male, *but lacking the black marks on front and labrum*. Thorax as in male. Abdomen shorter and thicker than in male, nearly cylindrical; colour orange or dull orange-brown, with an irregular longitudinal dorsal black band, and transverse basal and anal black bands on each segment; on each side a broad sublateral band of black reaching from middle of 3 to end of 8 and connected with the dorsal band by the transverse bands of each segment; underside yellowish, ventral carina blackish, 1-8 very hairy beneath.

Hab.—N.S.W.: Blue Mts., Blackheath, Katoomba, and Wentworth Falls, also National Park—Victoria: Mt. Macedon. Rare. October-February.

It inhabits mountain bogs and swamps; its flight and habits are very similar to the preceding species.

3. *N. OCCIDENTALIS*, n.sp. (Plate vi. fig.3).

♂. Total length 24-27.5 mm.; abdomen 15.5-18 mm.; forewing 18-19.5 mm.; hindwing 17-18.5 mm. Wings: *neuration* black, bases strongly saffroned for 1.2 mm.; *pterostigma* 1.2-1.6 mm., black with a small white area along inner margin and a larger triangular white area along the outer margin. [The peculiar formation of the pterostigma is shown in the enlarged fig.4 in the plate]; *membranule* almost nil; *triangle* of forewings abnormal, the proximal portion about twice as long as the distal portion; *triangle* of hindwings normal;* *only*

* Slightly abnormal in one or two specimens.

one cross-nervule in submedian space of all wings; 1-4 single cells following triangle of hindwings (generally 1-2). *Nodal Indicator*

||6 6-8| Head: *eyes* brown above, yellowish beneath; orbits
 ||4 6-8| black behind, spotted with yellow; *vertex*, *antennæ* and
ocelli black; *front* cleft medially, pale yellow with thick black
 hairs; *clypeus*, *labrum* and *labium* mustard-yellow; *mouth* edged
 with brown. Thorax: *prothorax* black, a short yellow collar
 in front, a central yellow spot, and a larger anal yellow spot.
Meso- and *metathorax* hairy, black, a touch of yellow along dorsal
 ridge; a pair of *broad* straight antehumeral yellow bands, some-
 what hooked inwards anally, followed closely in front and behind
 by a small yellow spot; below, on each side, a thick black band;
 rest of sides yellow, with an irregular black mark in the sublateral
 suture running to the coxæ and sending a short transverse branch
 upwards to join the black groundcolour in front; *underside*
 mustard-yellow with a pair of elongated black spots and a round
 dot between them; *notum* black, *scuta* and *scutella* yellow; several
 tiny yellow points at the wing-bases. *Legs* black with stiff spines,
coxæ yellow. *Abdomen* subcylindrical, flat underneath, 1-2
 slightly swollen, 3-5 cylindrical, 6-9 dilated, but not so much as
 in the two preceding species, 10 narrower. Colour: 1, very small,
 black above, a transverse anal line, sides yellow; rest of abdomen
 brilliant red in the mature insect; 2, with a black dorsal mark,
 irregular, and generally shaped like a stalked goblet; a touch of
 black on sides and on transverse carina; anal ends of all segments
 more or less shaded with dull black, either as a narrow anal band
 or a dorsal spot and a pair of distinct, very small, sublateral spots;
 10 short, red. In the teneral insect only the tip of the abdomen
 is red, the rest being orange, more or less marked with black.
Underside orange, ventral carina black. *Appendages*:
superior 1-2 mm., wavy narrow sub lanceolate, bases separated,
 tips almost touching; slightly hairy, orange-red, pointed. *Inferior*
 0.9 mm., subtriangular, tip slightly upcurved, dull orange; a small
 bunch of hairs beneath it on 10.

Mature males of this species show no signs either of pruinescence or any darkening of thorax and base of abdomen.

♀. Total length 24-26·5 mm.; abdomen 16-17·5 mm.; forewing 18-19·5 mm.; hindwing 17-18·5 mm. Wings as in male; bases more suffused with saffron (2-3 mm.), pterostigma somewhat larger. Head and thorax as in male. Abdomen broad, subcylindrical, 2-3 slightly narrower than rest, 4-8 broadening, narrower again. Colour: 1, black with basal and anal transverse yellow lines. Rest of abdomen either fulvous, brown or testaceous according to the individual and age; a more or less irregular black dorsal line all the way down, swelling out at both ends of each segment, very broad on 8-9. On each side an irregular black sublateral band along 2, half of 3, and 4 6 or 7; these two bands are connected with the dorsal band by transverse black bands across the sutures, those of 2-3 narrow, the others broader, and those of 7-9 separated by a fine orange line along the suture itself; 10, orange with a black basal spot. *Underside* very flat, orange, with the ventral carina broadly black; broad black bands across the sutures, carrying a pale spot on each side; 2-7 somewhat hairy beneath. Appendages 0·5 mm., wide apart, straight, pointed, slightly hairy, orange with blackish tips; separated by the tubercular projection of 10.

Hab.---South-Western Australia: Wilgarrup, near Bridgetown. Very rare. December-January.

Habits similar to those of the preceding species. It occurs in a tract of boggy country through which a small brook runs. It is a stronger and probably more active species than the other two, and has a zigzag and irregular flight.

In order to grasp more fully the important differences between these three closely allied species, I append a table of comparison for the chief characters in which they differ, in neurulation, size and colouration.

It seems fitting here to make a remark upon the group of allied genera, placed by authors at the end of the *Libellulinae*, which show an aberrancy in the formation of the triangle of one or both wings. Too much stress has been laid upon the possession of this remarkable property as regards its value in generic distinctions. There is no doubt of its importance, but there is also

CHARACTERS.	N. AUSTRALIS Br.	N. DALEI, n.sp.	N. OCCIDENTALIS, n.sp.
Size:—			
♂ { Total length.....	20-21 mm.	23-25 mm.	24-27·5 mm.
{ abdomen.....	13-13·5 mm.	15-16 mm.	15·5-18 mm.
{ forewing.....	14-14·5 mm.	17·5-18·5 mm.	18-19·5 mm.
{ hindwing.....	13·5-14 mm.	16·7-17·7 mm.	17-18·5 mm.
♀ { Total length.....	19-21 mm.	22 mm.	24-26·5 mm.
{ abdomen.....	12·5-13·5 mm.	14 mm.	16-17·5 mm.
{ forewing.....	15-16 mm.	17·5 mm.	18-19·5 mm.
{ hindwing.....	14·5-15·5 mm.	16·7 mm.	17-18·5 mm.
Neuration:—			
Antenodals of forewing	5	5	6
Postnodals „	4	5-6	6-8
Antenodals of hindwing	4	4	4
Postnodals „	4*	5-6	6-8
Number of discontinuous postnodals	1	2	2-4
Ratio of proximal to distal portion of upper side of triangle of forewings	1 : 1	2 : 1	2 : 1
Triangle of hindwings..	abnormal.	♂. normal. ♀. abnormal.	normal.
Number of cross-nerveules in submedian space of hindwing....	2 (rarely 3).	1	1
No. of single cells following triangle of forewings in discoidal area	3-5, generally 5.	2-3, generally 2.	1-4, generally 1-2.
Sectors of arculus arising	at or near base of arculus.	one-third from base of arculus.	one-third from base of arculus.
Position of inner angle of triangle of hindwing	slightly beyond arculus.	at arculus.	at arculus.
Colouration:—			
Pruinescence in adult ♂	complete on thorax and base of abdomen.	slight darkening of thorax.	nil.
Antehumeral thoracic stripes.....	narrow.	narrow.	broad.
Black mark on front....	absent.	present in male.	absent.
Black markings on abdomen of male.....	on segs. 1-6.	on segs. 1-6 (smaller).	on segs. 1-2.
Shape:—			
Constriction of segs. 3-5	very considerable	moderate.	slight.
Dilatation of 7-9	very great.	considerable.	fair.

* One specimen with 6 on one side only.

no doubt that it is so subject to variation that it is a dangerous guide to generic division. In the case of *Nannodythemis* as defined by Brauer, the importance attached to it has been so great that, if insisted on, we are driven to the absurdity of placing the male of *N. Dalei* in one genus and the female in another. This is sufficient to show that it has no generic value whatever. But rightly regarded, it possesses for us a far deeper significance. For these "quadrilateral" *Libellulinae* are survivals which take us back to a period long before the now dominant genera *Diplacodes*, *Orthetrum*, *Libellula* and many others had been formed. As *Nannodythemis*, *Nannophya*, and *Tetrathemis* are to the dominant *Libellulinae*, so are *Neophya*, *Cordulephya* and *Pentathemis* to our present-day *Corduliinae* (a group that can scarcely be called dominant). And in these three closely allied species of *Nannodythemis* we see taking place before our very eyes that excessive variation in the region of the triangle which was probably a heritage of an earlier period, when the "triangle" of the Anisoptera first became differentiated from the simpler quadrilateral cell of the Zygoptera. *N. australis* represents probably the oldest form, and tracing the gradual decrease of "abnormality" in the hindwing triangle through *N. Dalei* to *N. occidentalis*, we note the concurrence of greater size and more powerful build; the latter species suggesting at once that it would take but another step, viz., the change from an abnormal forewing triangle to a normal one, with another corresponding increase in size and strength of build, to give us the true Australian type of *Diplacodes* as represented by our *D. haematodes* or *D. bipunctata*. *Nannodythemis* then points to us the way by which the great dominant group of present-day *Libellulinae* have ascended in the scale of development, and it is not impossible that a careful study of this and allied genera, both in the *Libellulinae* and *Corduliinae*, may yet reveal the exact hidden homology between those portions of the Anisopterid and Zygopterid wings which lie close to the arculus. With the aid of more material and careful study of individual variations in each species, I hope to give later on in another paper some

interesting details about these remarkable "quadrilaterals," whose home is Australia and Papua.

EXPLANATION OF PLATE VI.

Fig. 1.—*Nannodythemis australis* Br., ♂ ($\times 2\frac{2}{3}$).

Fig. 2.—*N. Dalei*, n.sp., ♂ ($\times 2\frac{2}{3}$).

Fig. 3.—*N. occidentalis*, n.sp., ♂ ($\times 2\frac{2}{3}$).

Fig. 4.—*N. occidentalis*, n.sp., pterostigma of hindwing of ♂ ($\times 11$).